

RESEARCH NOTE

First report of the invasive slug *Boettgerilla pallens* Simroth, 1912 (Boettgerillidae) in the United States

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Abstract: *Boettgerilla pallens* Simroth, 1912 is reported for the first time in the United States. Identification was based on combined morphological and molecular data (mitochondrial *cytochrome c oxidase* I and 16S rRNA sequences) of a specimen collected in a retail garden center in northern California. We provide some background information on the biology and ecology of the slug and discuss the pest status of the species.

Key words: worm slug, European pest gastropod, subterranean slug, potted plants

Herein we report the first record of the European invasive slug *Boettgerilla pallens* Simroth, 1912 in the United States. The specimen was collected under a potted plant in a retail garden center in San Mateo in northern California (37°34'18"N; 122°18'57"W) on 27th January 2013. Other gastropod species collected with *B. pallens* at the garden center were *Arion hortensis* agg., *Deroceras laeve* (Müller, 1774), *Deroceras reticulatum* (Müller, 1774), *Lehmannia valentiana* (Férussac, 1821), and *Oxychilus cellarius* (Müller, 1774).

We confirmed the identification of *Boettgerilla pallens* using both morphological and molecular means. The dissected specimen has been deposited at Department of Malacology, Academy of Natural Sciences in Philadelphia under catalogue number ANSP A23428. Fragments of the mitochondrial *cytochrome c oxidase* subunit I (COI) and 16S rRNA genes were amplified and sequenced following the methods of Barr *et al.* (2009) using the Folmer *et al.* (1994) COI primer set LCO-1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO-2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3'), and the 16S primer set 16S-1 (5'-CGCCTGTTTAACAA-AAACAT-3') and 16S-2 (5'-ACGCCGGTTTGAAGTCAG-ATC-3'). COI and 16S sequences of the San Mateo specimen were deposited in GenBank (Benson *et al.* 2013) under accession numbers KF849344 (631 bp) and KF849350 (355 bp), respectively. When compared to other sequences from specimens collected in Germany and the United Kingdom (KF849345–KF849349, KF849351–KF849355), our slug was 100% identical

to *B. pallens* for both gene fragments. When compared to data on GenBank, the next best matches (87% for each gene) were to Helicarionidae samples. These results are, therefore, congruent with the morphological identification.

Boettgerilla pallens is a slender, medium sized slug up to 50 mm in length (Reise *et al.* 2000). It has a translucent appearance and tends to be yellowish gray, pale gray, or bluish gray (Fig. 1) with a contrasting darker colored head. The mantle of the slug is approximately one third the length of the body and the dark keel runs from the end of the mantle to the tip of the tail (Grimm *et al.* 2009). When fully extended it resembles an earthworm, hence its common name, the worm slug. *Boettgerilla pallens* is a burrowing species, often utilizing earthworm tunnels. It has been found at depths of 60 cm but it is thought that a small portion of the population remains at the ground surface under leaves, stones, and wood. It feeds on earthworm feces, eggs of other gastropods, carrion, fungal hyphae, roots, decaying vegetation, and detritus (Forsyth 2004). The worm slug is known from a wide range of habitats including gardens, grassland, woodland (deciduous and coniferous), greenhouses, and nurseries (Grimm *et al.* 2009, Reise *et al.* 2000) and is tolerant of a range of soil types, soil water content, and soil pH (De Wilde *et al.* 1983).

The native range of the species is thought to be the Caucasus in south-eastern Europe. Over the past sixty years the slug has spread rapidly throughout Europe, the former USSR and into the Americas, with first records from North America (British Columbia, Canada) in 1998 (Reise *et al.*



Figure 1. Specimen of *Boettgerilla pallens* Simroth, 1912 collected in San Mateo, California. Length of specimen is ~15mm. (Figure shown in color only in the electronic version).

2000) and from South America (Colombia) in 2000 (Hausdorf 2002). Although there is no evidence that *Boettgerilla pallens* is economically important, this may be an artifact of the primarily subterranean nature of the species, which likely makes it difficult to detect. Reise *et al.* (2000) also suggested that this uncertainty regarding the pest nature of the worm slug is compounded by the fact that other known pest species often co-occur with it (as was the case with our record; see above). Regardless of the pest status of *B. pallens*, its burrowing nature and presence in garden centers and nurseries has likely facilitated the spread of the species in potted plants. It is, therefore, very probable that the species exists in other parts of the United States as well and we hope that this note will stimulate research on and surveys for this understudied slug.

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